CLAIMS:

1. A multi-piece solid golf ball comprising a solid core, a mantle of at least one layer and a cover, wherein

the core is obtained by molding and vulcanizing a rubber composition comprising (A) 100 parts by weight of a base rubber which includes 60 to 100 wt% of a polybutadiene of at least 60 wt% cis-1,4 structure and synthesized using a rare-earth catalyst, (B) an unsaturated carboxylic acid or an unsaturated carboxylic acid metal salt or both, (C) an organic sulfur compound, (D) an inorganic filler and (E) 0.1 to 0.8 part by weight of organic peroxide, has a diameter of 30 to 40 mm and has a deflection when subjected to a load of 980 N (100 kg) of 2.5 to 6.0 mm;

the mantle is made primarily of a thermoplastic resin, has a thickness of at least 0.5 mm, has a Durometer D hardness of 30 to 70, and includes an outermost layer which is in contact with the cover and has a specific Durometer D hardness;

the cover is made primarily of a thermoplastic polyurethane, has a thickness of 0.5 to 2.5 mm and has a Durometer D hardness of 40 to 60 which is lower than the Durometer D hardness of the outermost layer of the mantle; and

the golf ball has a deflection when subjected to a load of 980 N (100 kg) of 2.0 to 4.0 mm.

2. The golf ball of claim 1, wherein the outermost layer of the mantle in contact with the cover has a Durometer D hardness of 45 to 70.

3. The golf ball of claim 1, wherein the polybutadiene in the base rubber of the rubber composition is a modified polybutadiene rubber synthesized using a neodymium catalyst, followed by reaction with a terminal modifier.

4. The golf ball of claim 1, wherein the rubber composition from which the core is made includes:

(A) 100 parts by weight of a base rubber,

(B) 10 to 60 parts by weight of an unsaturated carboxylic acid or an unsaturated carboxylic acid metal salt or both,

(C) 0.1 to 5 parts by weight of an organic sulfur compound,

(D) 5 to 80 parts by weight of an inorganic filler, and

(E) at least two different organic peroxides.

5. The golf ball of claim 1, wherein the cover is made of a composition consisting essentially of:

(G) a thermoplastic polyurethane material, and

(H) an isocyanate mixture obtained by dispersing (h1) an isocyanate compound bearing as functional groups at least two isocyanate groups per molecule in (h2) a thermoplastic resin which substantially does not react with isocyanate.

6. The golf ball of claim 1, wherein at least one layer of the mantle is made of a mixture comprising:
100 parts by weight of resin components which include

a base resin of (M) an olefin/unsaturated carboxylic acid binary random copolymer or a metal ion neutralization product of an olefin/unsaturated carboxylic acid binary random copolymer or both, and (N) an olefin/unsaturated carboxylic acid/unsaturated carboxylic acid ester ternary random copolymer or a metal ion neutralization product of an olefin/unsaturated carboxylic acid/unsaturated carboxylic acid ester ternary random copolymer or both in a weight ratio M/N of 100:0 to 25:75, in combination with

(P) a non-ionomeric thermoplastic elastomer
in a weight ratio (M+N)/P of 100:0 to 50:50;

(Q) 5 to 80 parts by weight of a fatty acid or fatty acid derivative having a molecular weight of 280 to 1,500, or both; and

(R) 0.1 to 10 parts by weight of a basic inorganic metal compound capable of neutralizing un-neutralized acid groups in the base resin and component Q.

7. The golf ball of claim 1, wherein at least one layer of the mantle is made of a mixture comprising:

resin components which include

at least one base resin selected from the group consisting of (M) olefin/unsaturated carboxylic acid binary random copolymers and metal ion neutralization products thereof and (N) olefin/unsaturated carboxylic acid/unsaturated carboxylic acid ester ternary random copolymers and metal ion neutralization products thereof, in combination with

(P) a non-ionomeric thermoplastic elastomer

in a weight ratio (M+N)/P of 100:0 to 50:50;

(Q) a fatty acid or fatty acid derivative having a molecular weight of 280 to 1,500, or both;

(R) a metal ion source capable of neutralizing un-neutralized acid groups in the base resin and component Q; and

(S) a compound which has a molecular weight of not more than 20,000 and bears at least two reactive functional groups.

8. The golf ball of claim 1, wherein at least one layer of the mantle is made primarily of a thermoplastic polyester.

9. A four-piece solid golf ball comprising a solid core, a two-layer mantle and a cover, wherein

the core is obtained by molding and vulcanizing a rubber composition comprising (A) 100 parts by weight of a base rubber which includes 60 to 100 wt% of a polybutadiene of at least 60 wt% cis-1,4 structure and synthesized using a rare-earth catalyst, (B) an unsaturated carboxylic acid or an unsaturated carboxylic acid metal salt or both, (C) an organic sulfur compound, (D) an inorganic filler and (E) 0.1

to 0.8 part by weight of organic peroxide, has a diameter of 30 to 40 mm and has a deflection when subjected to a load of 980 N (100 kg) of 2.5 to 6.0 mm;

the mantle is composed of an inner layer and an outer layer which is in contact with the cover, each of the two layers being made of a thermoplastic resin, having a thickness of 0.5 to 2 mm and having a Durometer D hardness of 30 to 70;

the cover is made primarily of a thermoplastic polyurethane, has a thickness of 0.5 to 2.5 mm and has a Durometer D hardness of 40 to 60 which is lower than the Durometer D hardness of the outer layer of the mantle; and

the golf ball has a deflection when subjected to a load of 980 N (100 kg) of 2.0 to 4.0 mm.

10. The golf ball of claim 9, wherein the outer layer of the mantle in contact with the cover has a Durometer D hardness of 45 to 70.

11. The golf ball of claim 9, wherein the polybutadiene in the base rubber of the rubber composition is a modified polybutadiene rubber synthesized using a neodymium catalyst, followed by reaction with a terminal modifier.

12. The golf ball of claim 9, wherein the rubber composition from which the core is made includes:

(A) 100 parts by weight of a base rubber,

(B) 10 to 60 parts by weight of an unsaturated carboxylic acid or an unsaturated carboxylic acid metal salt or both,

(C) 0.1 to 5 parts by weight of an organic sulfur compound,

(D) 5 to 80 parts by weight of an inorganic filler, and

(E) at least two different organic peroxides.

13. The golf ball of claim 9, wherein the cover is made of a composition consisting essentially of:

(G) a thermoplastic polyurethane material, and

(H) an isocyanate mixture obtained by dispersing (h1) an isocyanate compound bearing as functional groups at least two isocyanate groups per molecule in (h2) a thermoplastic resin which substantially does not react with isocyanate.

14. The golf ball of claim 9, wherein at least one layer of the mantle is made of a mixture comprising:
100 parts by weight of resin components which include

a base resin of (M) an olefin/unsaturated carboxylic acid binary random copolymer or a metal ion neutralization product of an olefin/unsaturated carboxylic acid binary random copolymer or both, and (N) an olefin/unsaturated carboxylic acid/unsaturated carboxylic acid ester ternary random copolymer or a metal ion neutralization product of an olefin/unsaturated carboxylic acid/unsaturated carboxylic acid ester ternary random copolymer or both in a weight ratio M/N of 100:0 to 25:75, in combination with

(P) a non-ionomeric thermoplastic elastomer
in a weight ratio (M+N)/P of 100:0 to 50:50;

(Q) 5 to 80 parts by weight of a fatty acid or fatty acid derivative having a molecular weight of 280 to 1,500, or both; and

(R) 0.1 to 10 parts by weight of a basic inorganic metal compound capable of neutralizing un-neutralized acid groups in the base resin and component Q.

15. The golf ball of claim 9, wherein at least one layer of the mantle is made of a mixture comprising:

resin components which include

at least one base resin selected from the group consisting of (M) olefin/unsaturated carboxylic acid binary random copolymers and metal ion neutralization products thereof and (N) olefin/unsaturated carboxylic acid/unsaturated carboxylic acid ester ternary random

copolymers and metal ion neutralization products thereof, in combination with

(P) a non-ionomeric thermoplastic elastomer

in a weight ratio (M+N)/P of 100:0 to 50:50;

(Q) a fatty acid or fatty acid derivative having a molecular weight of 280 to 1,500, or both;

(R) a metal ion source capable of neutralizing un-neutralized acid groups in the base resin and component Q; and

(S) a compound having a molecular weight of not more than 20,000 which bears at least two reactive functional groups.

16. The golf ball of claim 9, wherein the outer layer of the mantle is made primarily of a thermoplastic polyester.

17. The golf ball of claim 9, wherein the inner layer of the mantle is made primarily of a thermoplastic polyester.